Homogenization and Optimization of Electrodes and Photovoltaic Cells with Periodic Nanoscopic Geometry

Completed Technology Project (2011 - 2015)

Project Introduction

The purpose of this proposal is to design a completely propellantless spacecraft control system using magnetic actuators. The operational life and cost of a spacecraft is heavily influenced by its mass which makes propellantless spacecraft control systems an attractive alternative. An electrodynamic tether is a long conducting wire on a spacecraft that interacts with the Earth's magnetic field thereby exchanging orbital angular momentum with the Earth's rotational angular momentum. Electrodynamic tethers can either convert orbital energy into electricity or vice versa. Magnetic torque coils are coils placed on a spacecraft such that when current is passed through the coils in the presence of Earth's magnetic field, a torque is generated which causes an exchange of momentum. Magnetic torque coils provide a propellantless torque which can be used to rotate a spacecraft. However, they cannot generate a torque about the axis parallel to the magnetic field meaning that this axis will be uncontrollable. The goal of this proposal is to compensate for the lack of control by investigating a system consisting of both magnetic torque coils and electrodynamic tethers in order to generate a torque about the uncontrolled axis. My work will focus on the dynamics of the combined system as well as control laws to produce desired attitude or orbit changes. This project can benefit many mission types, especially small satellites that launch as secondary payloads. The ability to change orbit and perform any required attitude maneuvers without the use of propellant will be beneficial to any mission.

Anticipated Benefits

This project can benefit many mission types, especially small satellites that launch as secondary payloads. The ability to change orbit and perform any required attitude maneuvers without the use of propellant will be beneficial to any mission.

Project Image Magnetically Actuated Six Degree of Freedom Spacecraft Control Using Magnetic Torque Coils and Short Electrodynamic Tethers

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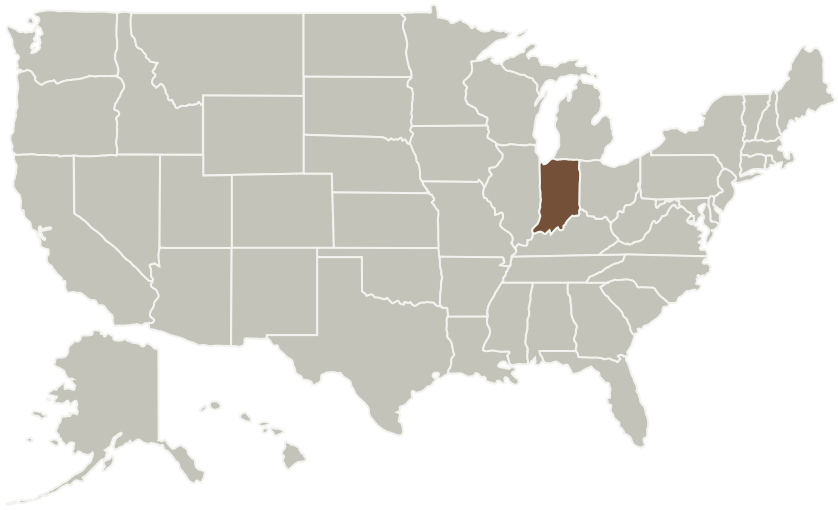
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Purdue University-Main Campus	Supporting Organization	Academia	West Lafayette, Indiana

Primary U.S. Work Locations
Indiana

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

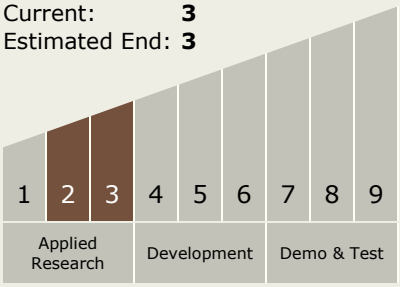
John Cushman

Co-Investigator:

Michael J Mueterthies

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Images

4227-1363188101473.jpg
Project Image Magnetically Actuated Six Degree of Freedom Spacecraft Control Using Magnetic Torque Coils and Short Electrodynamic Tethers
(https://techport.nasa.gov/image/1789)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.4 Advanced Propulsion
    - TX01.4.2 Electromagnetic Tethers